REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have cancelled claim 10 without prejudice or disclaimer, and have amended claim 12 to be a dependent claims, dependent on newly added claim 24 (discussed infra). Moreover, Applicants have amended claim 16 to recite that the water-retaining layer has a porous member which is provided adjoining the end of the plurality of the fuel cell units and has a water supplying surface to supply water to the flow channels, with water being supplied to the water-retaining layer from part of a surface opposite to the water supplying surface of the porous member and/or from the outer edge of the porous member. Claim 17 has been amended to recite that the fuel cell assembly includes a plurality of unit fuel cells, each unit fuel cell comprising specified structure, and that the assembly further comprises a humidifier adjoining and end of the plurality of unit fuel cells. Applicants have amended claim 18 to recite that the humidifier is connected to one end of the stack of unit fuel cells. Claim 19 has been amended to recite that water retained in the water-retaining layer is supplied to the flow channels from at least one of (a) part of the opposed surface of the porous member "to the surface from which water is supplied to the gas flow channels", and (b) the outer periphery of the porous member. Claim 22 has been amended to recite that the fuel cell assembly includes a plurality of unit fuel cells, each unit fuel cell having specified components, and the fuel cell assembly further comprises a humidifier, adjoining an end of the plurality of unit fuel cells.

In addition, Applicants are adding new claims 24-40 to the application. Of these newly added claims, claims 24 and 33 are independent claims, each reciting a fuel cell assembly comprising a humidifier and a plurality of fuel cell units, each of the

fuel cell units being defined. Claims 24 and 33 recite that the humidifier comprises a porous water-retaining layer for retaining water supplied thereinto, with the humidifier adjoining an end of the plurality of the fuel cell units in a specified manner.

Claims 25 and 34, dependent respectively on claims 24 and 33, recite that the humidifier further comprises a water permeable membrane located adjacent to the end of the plurality of fuel cell units and between the plurality of fuel cell units and the water-retaining layer. Claims 26 and 35, dependent respectively and claims 24 and 33, recite that the water-retaining layer adjoins the anode or cathode; and claims 27 and 36, dependent respectively on claims 25 and 34, recite that the water permeable layer adjoins the anode or cathode. Claim 28, dependent on claim 24, recites that the water-retaining layer is in contact with water in a cooling water channel; and claims 29 and 37, dependent respectively on claims 25 and 34, recite that the water-retaining layer takes water thereinto at a peripheral portion thereof, where the water-retaining layer is in contact with cooling water. Claims 30 and 38, dependent respectively on claims 24 and 33, recite that the water-retaining layer is made of a hydrophilic polymer material; and claims 31 and 39, dependent respectively on claims 24 and 33, recite that the water-retaining layer takes water thereinto at a peripheral portion thereof, where the water-retaining layer is in contact with cooling water. Claims 32 and 40, dependent respectively on claims 24 and 33, recite that the fuel cell assembly has a single humidifier.

In connection with amendments to previously considered claims, as well as in connection with the newly added claims, note, for example, Fig. 2 and the description in connection therewith, for example, on pages 11-21 of Applicants' specification.

The objection to claim 22 as set forth in Item 3 on page 2 of the Office Action mailed February 21, 2007, is moot, in light of present amendments to claim 22.

The rejection of claims 11, 16 and 19 under the second paragraph of 35 USC 112, as being indefinite, set forth in Items 5-8 on page 3 of the Office Action mailed February 21, 2007, is noted. In view of present amendments to claim 16, it is respectfully submitted that the rejection thereof as being indefinite is moot. Thus, it is respectfully submitted that claims 16, as presently amended, is clear with respect to the water supplying surface (that is, to supply water to the flow channels). In view of amendments to claim 19, it is respectfully submitted that the bases for rejection thereof under the second paragraph of 35 USC 112, set forth in Items 6 and 8 on page 3 of the Office Action mailed February 21, 2007, are moot. Thus, it is respectfully submitted that claim 19 is clear in reciting that the water retained in the water-retaining layer is supplied to the flow channels from specific parts of the porous member; in connection therewith, note, for example, page 11, lines 5-12, of Applicants' specification.

Applicants respectfully traverse the conclusion by the Examiner that there is insufficient antecedent basis for recitation of "said fuel cell assembly of claim 18" in claim 11. Thus, claim 11 is dependent on claim 18, thereby including all recitations of claim 18 therein. Claim 18 recites a "fuel cell assembly". Thus, it is respectfully submitted that claim 18 provides the necessary antecedent basis for "said fuel cell assembly" in line 4 of claim 11.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims on prior art grounds in the Office Action mailed February 21, 2007, that is, the teachings of the U.S. patent publications to Mossman, Patent Application Publication No. 2001/0046616, to Yi, et al., Patent Application Publication No. 2001/0004501, to Nakao, et al., Patent No. 4,909,810, and to

Marchand, et al., Patent No. 6,649,297, and Japanese Patent Document No. 07-320753 (Makihara), No. 08-138704 (JP '704), and No. 08-138705 (JP '705), under the provisions of 35 USC 102 and 35 USC 103.

It is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such a fuel cell assembly as in the present claims, including a humidifier and the plurality of fuel cell units (unit fuel cells), each of the fuel cell units including specified components, and wherein the humidifier comprises a water-retaining layer (in particular, a porous water-retaining layer), particularly having a mean micro-pore diameter for retaining water supplied thereinto, and wherein the humidifier adjoins an end of the plurality of the fuel cell units (note claims 17, 18, 22, 24 and 33), particularly wherein the humidifier adjoins such end in such a relation that the water-retaining layer faces the flow channels thereby to transfer water introduced into the water-retaining layer to the fuel gas and/or oxidizing gas flowing in the flow channels (see claims 24 and 33).

That is, in addition to the plurality of unit fuel cells each having the anode, electrolyte and cathode, the fuel cell assembly further comprises a humidifier, specifically positioned adjoining an end of the plurality of unit fuel cells.

Furthermore, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such fuel cell assembly as in the present claims, having the above discussed humidifier and plurality of fuel cell units, with positioning of the humidifier, and with the humidifier having a hydrophilic water-retaining layer which has a mean micro-pore diameter of 10-300 μm and a thickness of 50-300 μm, as in claims 17, 18 and 22, and whereby water is retained by capillary force by the water-retaining layer when the plurality of unit fuel cells is not working and is taken by gas fed to the cells (anode or cathode) against the

capillary force when the plurality of unit fuel cells is working. See claims 17, 18 and 22.

Moreover, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such fuel cell assembly as in the present claims, having features as in independent claims 12, 17, 18, 22, 24 and 33, as discussed previously, and additionally having features as set forth in the present dependent claims, such as (but not limited to) wherein the porous member (of which the water-retaining layer is made) is made of a hydrophilic polymer material, a carbonaceous porous material, or a composite material thereof (see claim 2); and/or wherein the thickness of a humidifying water inlet of the humidifier is ½ to ¾ of the thickness of the porous member (see claim 3); and/or wherein a water permeable membrane having a function to transmit water is formed on porous material of the water-retaining layer (see claim 4), more particularly, the size and porosity of the water permeable membrane respectively as in claims 5 and 6, and material of the water permeable membrane as in claim 7; and/or wherein the water-retaining layer of the humidifier has a carbonaceous porous filter, as in claim 8; and/or wherein this porous member has a hydrogen-oxidizing catalyst dispersed therein (see claim 9); and/or a power generation system including, inter alia, the fuel cell assembly of claim 18, as in claim 11; and/or wherein the water-retaining layer has a hydrophilic porous member as in claim 13; and/or wherein the water-retaining layer has a porous member provided adjoining the end of the plurality of fuel cell units and has a water supplying surface to supply water to the flow channels, with water being supplied to the water-retaining layer from part of a surface opposite to the water supplying surface of the porous member and/or from the outer edge of the porous member (see claim 16); and/or wherein water retained in the water-retaining layer is supplied to the flow

channels from at least one of (a) part of the opposed surface of the porous member to the surface from which water is supplied to the flow channels, and (b) the outer periphery of the porous member (see claim 19); and/or wherein the fuel cell assembly has at least two water-retaining layers (see claim 20); and/or wherein the carbonaceous porous filter controls flow rate of water to the water-retaining layer (see claim 21); and/or wherein the water-retaining layer is a material as set forth in claim 23 (see also claims 30 and 38); and/or wherein the humidifier further includes a water permeable membrane, positioned as set forth in claims 25 and 34; and/or further definition of position of the water-retaining layer or water permeable layer as in claims 26-28, 35 and 36 (see also claims 29, 31, 37 and 39); and/or wherein the assembly has a single humidifier (see claims 32 and 40).

The invention as claimed in the above-identified application is directed to a fuel cell assembly including a plurality of unit fuel cells, and a power generation system using such fuel cell assembly. In particular, the present invention is directed to such fuel cell assembly, and such power generation system, including polymer electrolyte fuel cells.

As described on page 1 of Applicants' specification, a unit fuel cell of the polymer electrolyte fuel cell (PEFC) includes a membrane-electrode assembly having a proton exchange membrane, which is a proton-conductive membrane sandwiched between porous electrodes, and a unit cell separator having gas flow channels which supply hydrogen gas to the anode and air (oxygen) to the cathode, respectively. The proton exchange membrane must be kept wet to a certain level, to let protons move; and various mechanisms have been proposed as apparatus to humidify fuel gasses, as described on pages 2 and 3 of Applicants' specification. Various previously proposed humidifiers have problems such as consuming power, which reduces

efficiency of the fuel cell system, and disadvantageously increasing size of the assembly.

Against this background, Applicants provide a fuel cell assembly including a humidifier, which avoids problems of previously proposed humidifiers, avoiding a reduction in efficiency of the fuel cells and avoiding an increase in the size of the assembly. The fuel cell units of the present invention are simply constructed of minimum elements, so that total volume is minimized and is fabricated at reduced cost. Furthermore, the present invention, having minimal number (e.g., one or two) humidifiers, is very flexible in design thereof. Applicants have found that by utilizing a humidifier adjoining an end of the plurality of cells, the humidifier, e.g., having a water-retaining layer having a mean micro-pore diameter and thickness as in the present claims, particularly wherein this water-retaining layer is made of a hydrophilic porous member, and whereby water is retained by capillary force by the water-retaining layer when the plurality of unit fuel cells is not working and is taken by the oxidizing/fuel gasses against the capillary force when the plurality of unit fuel cells is working, excess humidification of the fuel/oxidizing gasses can be avoided, and a simple and effective humidification of the fuel/oxidizing gasses can be provided, with other advantages as discussed previously in this paragraph. Note, for example, the paragraph bridging pages 9 and 10, as well as the sole full paragraph on page 10, of Applicants' specification.

Moreover, the gasses can be humidified to required degrees according to the flow rate of the gasses, by a simple and efficient technique forcing the water to the gasses fed to the anode and cathode against the capillary force when the plurality of fuel cells is working.

It is emphasized that according to the present invention, the humidifying water humidifies the fuel gas and/or oxidizing gas when there are gas-flows, e.g., upon starting and operation of the plurality of fuel cells; and when the plurality of fuel cells is stopped to stop the gas-flow, water is retained in the micro-pores by the capillary action. Accordingly, the water-retaining layer properly humidifies the fuel gas and/or oxidizing gas, without excessively humidifying the gas.

No. 07-320753 (Makihara) discloses a solid polymer electrolyte membrane fuel cell, including a separator made of a hydrophilic porous body having an average pore diameter of about 10-100 μm but actually having smaller and larger diameter pores as a pore diameter distribution, the supplied water filing in the small diameter pores as liquid water by capillary condensation, and distributed all over the surface of a hydrogen electrode side electrode diffusion layer of a cell to humidify a hydrogen electrode. This patent document discloses that the larger diameter pores in the separator have no condensed water and are left as continuous pores, with hydrogen-containing wet gasses freely moving and diffusing inside the pores, and hydrogen serving as fuel is distributed all over the surface of the hydrogen electrode side electrode diffusion layer. Note the English abstract of No. 07-320753. See also the computer translation of paragraphs [0018], [0019] and [0023]-[0025].

As can be seen, for example, in the drawing figures of No. 07-320753, each of the unit fuel cells therein include the separator 1B. It is respectfully submitted that this reference does not disclose, nor would have suggested, such assembly as in the present claims, having a humidifier and the plurality of fuel cell units, with the humidifier adjoining an end of the plurality of the fuel cell units, and advantages of the present invention due thereto, e.g., reduced size of the assembly and reduced cost.

Moreover, it is respectfully submitted that the teachings of No. 07-320753 would have neither disclosed nor would have suggested the other features of the present invention as discussed previously, having the features of the plurality of fuel cell units and the humidifier, discussed previously.

It is respectfully submitted that the secondary reference as applied by the Examiner, utilizing No. 07-320753 as the primary reference, would not have rectified the deficiencies of the applied Japanese patent document, such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Yi, et al. discloses fuel cell power plants utilizing a water transport plate having interdigitated flow channels therein to furnish reaction gasses to the fuel cell. The power plant includes a fuel cell including a membrane electrode assembly which is disposed between an anode support plate and a cathode support plate and wherein the anode and/or cathode support plates include a hydrophilic substrate layer, and a cooling water stream, which is in fluid communication with both the anode and cathode support plate hydrophilic substrate layers. Note particularly paragraphs [0009]-[0011] on page 2; paragraphs [0014] and [0037]-[0039] on pages 3 and 4; paragraphs [0054]-[0056] on page 6; and paragraph [0065] on page 8, of Yi, et al.

As with No. 07-320753, Yi, et al. includes hydrophilic substrate layers for the anode and/or cathode support plates for each of the fuel cells. It is respectfully submitted that the combined teachings of No. 07-320753 and of Yi, et al. would have taught away from the presently claimed subject matter, having a humidifier adjoining an end of the plurality of fuel cell units, and advantages thereof, and would have neither disclosed nor would have suggested the other features of the present

invention, including wherein the structure includes a single humidifier, and advantages thereof.

Marchand, et al. discloses a bipolar plate for a fuel cell, which includes on at least one of its faces, at least one flute able to form with the surface of an adjacent electrode, at least one gas distribution channel, wherein the distribution channel has a shape or geometry so that the liquid of the biphasic flow flowing in the channel may be moved away from the electrode surface. Note the paragraph bridging columns 3 and 4 of this patent. As for the cell structure, and as applied by the Examiner, Marchand, et al. discloses an electrode/membrane/electrode set 84 (note Fig. 9) with channels 83 being alternately defined for distributing anode gas such as hydrogen and cathode gas (82) such as oxygen, with channels (85) used for thermal monitoring of the cell. A porous plate (90) is placed in contact with the plate (92), the porous components (90) placed at the bottom of the channels (82, 83) being able to provide capillary drainage of water and/or its distribution and its redistribution, for example for humidifying the gasses. Note column 10, line 58 to column 11, line 6.

Yi, et al. has been previously discussed.

It is respectfully submitted that Marchand, et al. includes the porous plate in connection with each of the unit fuel cells. Even assuming, arguendo, that the teachings of Marchand, et al. and of Yi, et al. were properly combinable, such combined teachings would have neither disclosed nor would have suggested the presently claimed invention, including the humidifier and plurality of unit fuel cells, with a humidifier adjoining an end of the plurality of unit fuel cells, and advantages thereof.

The remaining rejections on prior art grounds, in Items 12-17 on pages 7-11 of the Office Action mailed February 21, 2007, utilize the combined teachings of Marchand, et al. and of Yi, et al., together with additional references. As will be shown

in the following, it is respectfully submitted that the additional applied references, even in combination with the teachings of Marchand, et al. and Yi, et al., would not have rectified the deficiencies of the combined teachings of Marchand, et al. and of Yi, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

In connection with the rejections set forth in Items 12, 13 and 16 of this Office Action mailed February 21, 2007, JP '704 discloses a hydrogen gas humidifier constituted with a porous film 111 and separators 113, 115, which interpose the porous film 111 from both sides and form a hydrogen gas flow path 113p and a water flow path 115p, respectively, the porous film 111 being a polyolefin porous film and having a hydrophilic nature. This patent document discloses that water is easily vaporized by receiving heat from both the porous film 111 and the hydrogen gas, humidification being conducted in a good state of steam.

It is respectfully submitted that the teachings of JP '704, even in combination with the teachings of Marchand, et al. and of Yi, et al. would have neither disclosed nor would have suggested a humidifier in combination with the plurality of fuel cell units, and together with location of the humidifier relative to the plurality of fuel cell units, and advantages thereof as discussed previously.

In addition, it is respectfully submitted that JP '704 discloses that a micropore size of the water-retaining layer 111 is 0.01-0.1 μm. It is respectfully submitted that this disclosure in JP '704, even in combination with the teachings of the other references relied upon by the Examiner, would have taught away from that aspect of the present invention as in claim 3, including pore size of the water-retaining layer.

Mossman discloses a membrane exchange humidifier, particularly for use in humidifying reactant streams for solid polymer electrolyte fuel cell systems, wherein a

hydrophilic additive or filler is included. Note paragraphs [0012] and [0014]-[0017] on pages 2 and 3 of Mossman.

Even assuming, arguendo, that the teachings of Mossman were properly combinable with the teachings of the other references as applied by the Examiner, such combined teachings would have neither disclosed nor would have suggested the presently claimed assembly, including a humidifier in combination with the plurality of fuel cell units, with the humidifier adjoining an end of the plurality of fuel cell units, and advantages thereof.

JP '705 discloses a hydrogen gas humidifier 20 constituted with a porous film 21, a catalyst reaction layer 22 formed on its one side surface, and separators 24 which interpose the porous film 21 and the catalyst reaction layer 22 from both sides and form a hydrogen gas flow path 23p and a water flow path 24p respectively. Water in the water flow path 24p permeates the porous film 21 and the catalyst reaction layer 22 according to the difference between the pressure of water flowing in the water flow path 24p and the pressure of hydrogen gas 23p flowing in the hydrogen gas flow path 23p.

Even assuming, arguendo, that the teachings of JP '705 would have been properly combinable with the teachings of Marchand, et al. and of Yi, et al., as applied by the Examiner in Item 15 on page 9 of the Office Action mailed February 21, 2007, such combined teachings would have neither taught nor would have suggested the presently claimed subject matter, including the assembly having a humidifier and the plurality of fuel cell units, and positioning of the humidifier adjoining an end of the fuel cell units, and advantages thereof, as discussed previously.

Nakao, et al. discloses a (water) vapor permselective membrane and a method for selectively permeating and separating water or water vapor from a moisture-

containing gas by means of an ion exchange membrane, for production of moisture-reduced air or for removal of moisture. See column 1, lines 4-18. The vapor permselective membrane consists essentially of an ion exchange membrane made of a fluorine-containing polymer having a specified fixed ion concentration, water content and ion exchange capacity, the ion exchange membrane having a thickness of from 0.1-300 μm and a moisture content of from 1-10% by weight, the membrane having a specified water vapor permeation rate. See column 2, lines 58-67. Note also column 3, lines 14-22. See, further, column 6, lines 12-18 and 39-53; column 7, lines 38-40; and column 8, lines 14 and 15.

Noting that Nakao, et al. discloses vapor permselective members for production of moisture-reduced air, or for removal of moisture, it is respectfully submitted that one of ordinary skill in the art would not have looked to the teachings of this reference, in connection with modification of humidifiers. Thus, in view of differences in technologies involved in Marchand, et al. and Yi, et al., on the one hand, and Nakao, et al., on the other, and different problems addressed by each, it is respectfully submitted that one of ordinary skill in the art concerned with in, e.g., Marchand, et al., would not have looked to the teachings of Nakao, et al.

In any event, even assuming, arguendo, that the teachings of Nakao, et al. were properly combinable with the teachings of the other references as applied by the Examiner, such combined teachings would have neither taught nor would have suggested such assembly as in the present claims, with a humidifier and plurality of fuel cell units, and positioning of the humidifier relative to the plurality of fuel cell units, and advantages thereof.

In view of the foregoing comments and amendments, entry of the present amendments, and reconsideration and allowance of all claims pending in the above-identified application, are respectfully requested.

Applicants request any shortage in fees due in connection with the filing of this paper be charged to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (case 520.43216X00), and credit any excess payment of fees to such Deposit Account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP

By /William I. Solomon/
William I. Solomon
Registration No. 28,565

WIS/ksh
1300 N. Seventeenth Street
Suite 1800
Arlington, Virginia 22209
Tel: 703-312-6600
Fax: 703-312-6666